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# Simulation of Thermal Breakdown in a Multi-layered Stack of Dielectric Elastomers

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Several aging mechanisms are prone to occur during operation of dielectric elastomers. Some breakdown mechanisms are somewhat instantaneous, such as electrical, electro-mechanical and thermal breakdowns, while others are slow in order of hours, such as electrical and water trees. One of the most significant aging mechanisms is thermal breakdown, which increases its frequency significantly when stacking multiple layers of dielectric elastomers. Thermal breakdown occurs due to build-up of heat within the stacked dielectric elastomer. Heat is generated mainly through Joule heating, and if the heat generated exceeds the heat loss at the surface of the stack, the temperature will increase exponentially and a thermal breakdown is likely to occur. Thermal breakdown may happen either locally or macroscopically.

The focus of our work is to obtain a better understanding of thermal breakdown in a multi-layered stack of dielectric elastomers. This we obtain by performing numerical simulations in COMSOL Multiphysics® where joule heating and deformation, due to an externally applied voltage, is combined. From the simulation results the importance of thermal breakdown has been examined, and furthermore it has been studied how various parameters affect the point of thermal breakdown. The material of interest is PDMS which is modelled using experimentally determined material parameters and using the Yeoh model as the hyperelastic material model.